

## Surprise Vectors Quiz

Expectation	Level Achieved
C4 - represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections	

1. If  $\vec{a} = [-1, 2, 4]$  and  $\vec{b} = [3, 4, -10]$ , determine:

<p>a) <math>\vec{b} - \vec{a}</math></p> $= \vec{a} - \vec{b}$ $= (-1-3, 2-4, 4-(-10))$ $= (-4, -2, 14)$	<p>b) a vector perpendicular to both <math>\vec{a}</math> and <math>\vec{b}</math></p> $\vec{a} \times \vec{b} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -1 & 2 & 4 \\ 3 & 4 & -10 \end{vmatrix}$ $= (-20-16, 12-10, -4-6)$ $= (-36, 2, -10)$
<p>c) the angle between <math>\vec{a}</math> and <math>\vec{b}</math></p> $\vec{a} \cdot \vec{b} =  \vec{a}   \vec{b}  \cos \theta$ $(-1)(3) + (2)(4) + 4(-10) = (\sqrt{1+2^2+4^2})(\sqrt{3^2+4^2+10^2}) \cos \theta$ $-35 = (\sqrt{21})(5\sqrt{5}) \cos \theta$ $\frac{-35}{(\sqrt{21})(5\sqrt{5})} = \cos \theta$ $\theta = 126^\circ$	<p>d) <math>3\vec{a} \cdot 5\vec{b}</math></p> $= 3(-1, 2, 4) \cdot 5(3, 4, -10)$ $= (-3, 6, 12) \cdot (15, 20, -50)$ $= (-3)(15) + (6)(20) + (12)(-50)$ $= -45 + 120 - 600$ $= -525$

2. Suppose line L passes through A (3, 2, -5) and B (7, -2, 6). Express the equation for L in each of the following forms;

a) vector

$$\vec{r} = (7-3, -2-2, 6-(-5))$$

$$= (4, -4, 11)$$

$$\vec{r} = \vec{r}_0 + t\vec{m}$$

$$= (3, 2, -5) + t(4, -4, 11)$$

b) parametric

$$x = 3 + 4t$$

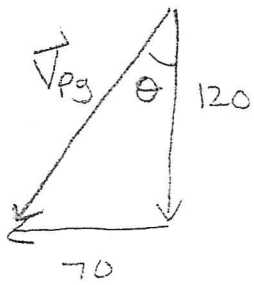
$$y = 2 - 4t$$

$$z = -5 + 11t$$

c) symmetric

$$\frac{x-3}{4} = \frac{y-2}{-4} = \frac{z+5}{11}$$

3. A small airplane is flying due South at 120km/h when it encounters a wind of 70km/h from the east. What is the resultant ground velocity of the airplane?

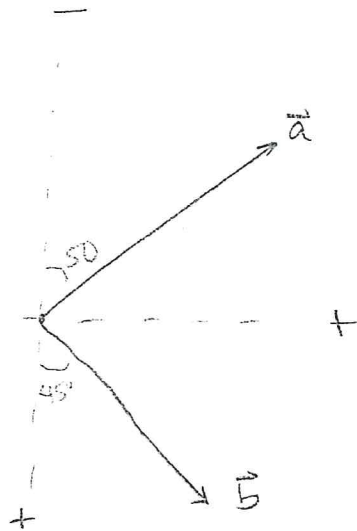


$$\begin{aligned} V_{pg} &= \sqrt{120^2 + 70^2} \\ &= 10\sqrt{193} \\ &\approx 138.9 \text{ km/h} \end{aligned}$$

$$\begin{aligned} \theta &= \tan^{-1}\left(\frac{70}{120}\right) \\ &= 30^\circ \end{aligned}$$

$$V_{pg} = 138.9 \text{ km/h [S } 30^\circ \text{ W]}$$

4. If  $\vec{a} = 52\text{km[N } 50^\circ \text{ E]}$  and  $\vec{b} = 47\text{km[S } 45^\circ \text{ E]}$ , find  $\vec{a} + \vec{b}$



$$\begin{aligned} |\vec{a} + \vec{b}| &= \sqrt{\quad} \\ &= 73.07 \text{ km} \end{aligned}$$

$$\begin{aligned} \theta &= \tan^{-1}\left(\frac{0.191}{73.07}\right) \\ &= 0.15^\circ \end{aligned}$$

$$\vec{a} + \vec{b} = 73.07 \text{ km [E } 0.15^\circ \text{ N]}$$

	X	Y
$\vec{a}$	$52 \sin 50^\circ$	$-52 \cos 50^\circ$
$\vec{b}$	$47 \cos 45^\circ$	$47 \sin 45^\circ$
$\vec{a} + \vec{b}$	73.07	-0.191

